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—

THE MUSICAL INSTRUMENTS OF THE INCA

BY

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Author's Note

Most of the text in this paper appeared under the present title in 1903, as a Guide Leaflet, supplementary to the American Museum Journal. At that time no one had given the subject much attention, and, though a number of musical instruments were to be found in museum collections, absolutely nothing was known concerning the music of the ancient Peruvians. However, during the twenty or more years that have passed, additional instruments have been discovered and several competent investigations made into the character of the ancient music itself as found still surviving in Peru and Bolivia. In all, a large number of songs has been collected from the Indians of the Sierras, quite a number of which are in the pentatonic, or five-toned scale, which is generally regarded as the first stage in real musical development. All these studies and the new material they have brought to light, made it possible to add new matter and thus make what is, in the main, a new paper.

Charles W. Mead.

June, 1924

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Introduction

Ancient Peru, the land of the Inca, extended, according to the historians, Garcilasso de la Vega[1] and Prescott,[2] from about the second degree of north latitude to the Maule River in Chile, about the thirty-sixth degree of south latitude. The country included the region now comprised within the Republic of Peru, and the greater part of Ecuador, Bolivia, and northern Chile, and was nearly equal in size to that part of the United States east of the Rocky Mountains. The Inca had no written language, and no small part of our knowledge of their customs has been derived from their practice of representing the scenes of daily life in the decoration of their pottery vessels. In the study of the musical instruments, in particular, the decorations on the pottery of the ancient Peruvians is important, because the Spanish conquerors and their followers have left in their accounts but little information bearing upon the subject. From the pottery and other objects found in the ancient tombs and burial places, therefore, we have derived most of our knowledge of the musical instruments of the Inca. The present discussion is based upon a study of the prehistoric Peruvian collections in the American Museum of Natural History. In these collections are not only many of the musical instruments themselves, but also artifacts, principally pottery vessels, decorated with figures of men in the act of playing upon such instruments.

It is commonly said that "Peru is a puzzle"; certainly this may be truthfully said of its music. Although we find recorded a number of characteristic songs, known to the Peruvian Indians for nearly two hundred years, we cannot say positively of any one of them that it is wholly pre-Spanish. Dr. von Tschudi has published three Peruvian elegiac songs or *haravis*[3] which he says "might serve to test the musical knowledge of the ancient Peruvians," but an examination of these pieces is very disappointing. Carl Engel remarks:—

> At all events they must have been tampered with, as they exhibit exactly the form of the Spanish *bolero*. Even allowing that the melodies of these compositions have been derived from Peruvian *haravis*, it is impossible to determine with any degree of certainty how much in them has been retained of the original tunes, and how much has been supplied besides the harmony, which is entirely an addition of the European arranger.[4]

The first and simplest element of music is rhythm, and in singing or dancing, a desire for some sound that shall clearly mark it, is universal; hence, in the absence of musical instruments, the custom of snapping the

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[1] *Royal Commentaries of Peru.* Ed. Rycaut, Part I, Book, I, Chap. III.
[2] Prescott, William H., *History of the Conquest of Peru*, vol. 1, 28.
[3] Tschudi, Juan Diego y Rivero, Mariano E., *Antiguedades Peruanas*, (Vienna, 1851), 135, 136.
[4] *Musical Instruments*, 79.

fingers, clapping the hands, beating the hips and stamping the feet; and I am inclined to follow Rowbotham[1] in believing that the art of instrumental music in prehistoric times passed through three stages, which may be designated the "drum", the "pipe", and the "lyre" type. The first type includes all instruments of percussion, as drums, rattles, gongs, castanets, etc.; the second, all wind instruments; and the third, all stringed instruments. In support of this theory he cites the evidence furnished by the mechanical complexity of the instruments themselves. The drum is the simplest form; the pipe is more complex than the drum; and the lyre, which makes use of stretched strings, is the most complex of all.

That the drum was the first instrument of primitive man is strenuously opposed by Wallaschek, who says:—

> The most ancient discoveries (from the youth of mankind) of flutes and pipes, but not of drums, are definite facts which no speculation can put aside, and I am rather inclined to believe that Wagener was correct in saying that a wind instrument was undoubtedly the first.[2]

The entire absence of drums and the large number of flutes in the prehistoric Peruvian collections in museums would seem to support this claim in Peru were it not for the fact that numerous pottery vessels decorated with figures in the act of beating the drum are found with mummies in the ancient graves. (See Plate V).

The fact that a tribe has flutes and no drums is not proof that its earliest instrument was not the drum for there are well-known cases of the "dropping out" of musical instruments. In Guatemala the *marimba* has become a national instrument. Professor O. T. Mason, referring to this instrument, says:—

> In one case we have a musical instrument imported by negro slaves given to the Indians with its native African name and abandoned by the negroes themselves.[3]

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[1]Rowbatham, J. F., "Art of Music in Prehistoric Times" (*Journal, Anthropological Institute of Great Britain and Ireland*, vol. 10, 380–388, London, 1881).

[2]Wallaschek, Richard, *Primitive Music. An Inquiry into the Origin and Development of Music, Songs, Instruments, Dances, and Pantomimes of Savage Races.* London, 1893.

[3]Mason, Otis T., "Geographical Distribution of the Musical Bow" (*American Anthropologist*, vol. 10, 377–380, 1897).

Instruments of Percussion

In instruments of this class the drum undoubtedly held the first place, although, as has been stated, none has been found in the ancient graves up to the present time. This may be accounted for by the perishable material of which they were made; or, through the existence of some superstition on account of which they may never have been buried with the dead. However this may be, the numerous representations on pottery vessels, and the accounts of early writers, give us a fairly accurate idea of their form and construction.

Drums. The drums appear to be identical with those in use in many parts of Peru today and were made by stretching a skin over a hoop of wood or over one end of a short section of the trunk of a tree which had been hollowed out to a thin cylinder. These two forms of drum are shown on Plate VI, where two men (Figs. 7 and 10) are beating very thin drums, which seem to represent the hoop form, while another drummer (Fig. 9) plays upon one much thicker, which is probably of the second type. Judging from these representations, the drums would not exceed fourteen or fifteen inches in diameter. We are told frequently by early writers that small drums were used on different occasions; but no mention of larger ones, so common in many Indian tribes, has been found. The Abbé Molina, describing the method of curing the sick, says:—

> The *Machi* directs the women who are present to sing with a loud voice a doleful song, accompanied with the sound of some little drums, which they beat at the same time.[1]

Doubtless the heads of these drums were usually made of the skin of the deer and other animals common to the country, but this was not always the case. The Huancas "flayed the captives they took in war, making some of the skins into drums."[2] Garcilasso says:—

> They were a sort of fierce and warlike people fleaing those whom they took in the wars, the skins of which they filled with ashes and hanged them up in the temples for trophies; with the skins of some they make drums, being of opinion that the sound of them would terrify their enemies.[3]

Bells. Copper bells, in form resembling our sleigh bells, appear to have been in common use. Figs. 2, 3, and 4 of Plate VI show three, each of which has a pebble in the cavity. Fig. 1 shows a flattened form, decorated on either side with a figure, probably representing the sun. This

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[1]Molina, Abbe Don J. Ignacius, *The Geographical, Natural and Civil History of Chili* (Middletown, 1808), 92.

[2]Cieza de Leon, Pedro de, "Travels of Cieza de Leon, A.D. 1532–50, contained in the First Part of his Chronicles of Peru" (*Hakluyt Edition, translated and edited by Sir Clements Markham*, London, 1864), 299.

[3]*Royal Commentaries of Peru*, Part 1, Book 6, Chap. 10.

bell has been broken, and the pebble or "clapper" is missing. Cieza de Leon, who is perhaps the most reliable of the contemporaneous writers, remarks:—

> When the chiefs [Guayaquil, Ecuador] were sick, to appease the wrath of their gods, and pray for health, they made other sacrifices of a superstitious nature; killing men (as I was told), and believing that human blood was a grateful offering. In doing these things they sounded drums and bells before certain idols shaped like lions and tigers, which they worshipped.[1]

In the Museum collection there are three bronze objects, circular in outline and slightly concavo-convex, each having a projection perforated for suspension. When struck with any hard substance, they give out a remarkably clear and resonant sound. One of these is shown as Plate VI, Fig. 12. It is three and seven-eighths inches in diameter. Ewbank, describing Señor Barboza's collection of Peruvian antiquities, figures three of these objects, two of which he states are of copper and one of bronze. He says: "I took them for mirrors; but they do not seem to have been polished."[2] None of the three in the Museum shows any indication, on either side, of having been polished, and there seems to be no reason to doubt that they were used as gongs or bells.

Rattle and Cymbal. Of the various forms of rattles it is hardly necessary to speak in detail. They consisted of small shells and nuts, seeds of a species of laurel tree, etc., and were often strung together. (See Plate VI, Fig. 8 and Plate VII, Figs. 5, 7, 8.) These were attached to the wrists, ankles, and other parts of the body in dancing. A common form of rattle was a gourd containing seeds or pebbles. The use of shells as paint cups or palettes was very common, as is attested by numerous specimens which still contain paint found in graves; but their use as musical instruments in ancient Peru, has not been noticed before. Figs. 5 and 6 of Plate VI, represent water vessels of terra cotta, decorated with figures striking shells together, as cymbals are played. The "cymbals" are so well modeled that there can be no doubt that they represent Spondylus (*Spondylus pictorum*, Chem.) shells. (Plate VI, Fig. 11.)

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[1] *Travels of Cieza de Leon*, 203.

[2] Ewbank, Thomas, *Life in Brazil; or a Journal of a Visit to the Land of the Cocoa and the Palm* (New York, 1856), Appendix, 454.

Wind Instruments

Syrinx or Panpipe. Long before the Conquest the Peruvians had emerged from the first or drum stage, and reached the second, which C. K. Wead defines as that "having instruments mechanically capable of furnishing a scale"[1]—a tremendous stride in the art. The most important instruments of this class are the syrinx or panpipe (*huayra puhura*) and the flutes of bone and cane. Plate VIII, Fig. 7 shows a syrinx consisting of eight reeds of graduated lengths, held in position by a crosspiece of split cane lashed to the reeds with a cord made of the wool of the llama. This pipe has all the reeds open at the lower ends, and yields the following scale:—

Other panpipes are found with reeds closed at the lower end; and still another form has a double set of the same dimensions,—one set open at the bottom and the other closed, those of corresponding length being placed opposite each other. By this arrangement octaves are produced, the closing of a pipe at one end, as is well known, lowers its pitch an octave. This same law is utilized by the modern organ builder in the employment of the so-called open and stopped diapasons.

Two panpipes that are complementary, one furnishing the notes that are lacking in the other, are in common use today in parts of South America, particularly in Bolivia. They are connected by a long cord and the two performers must sound a note alternately in order to produce a scale. The Inca had these pipes, as they represented them on their pottery vessels.

A curious and unique syrinx of stone is shown as Plate VII, Fig. 3. The illustration is made from a plaster cast. The original, which was procured by the French general, Paroissien, is made of greenish talc, and is said to have been found on a mummy in a Peruvian tomb. This interesting specimen has been described at length by Carl Engel.[2] Plate VIII, Figs. 1 and 2 represent water jars, in human form, made of terra cotta; both figures are represented in the act of playing the panpipes. Garcilasso says:—

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[1]Wead, C. K., "Contributions to the History of Musical Scales" (*Report, United States Nationa Museum for 1900*, pp. 417–462, Washington, 1902), 421.

[2]*Musical Instruments*, 66.

In music they arrived to a certain harmony, in which the Indians of Colla did more particularly excel, having been the inventors of a certain pipe made of canes glued together, every one of which having a different note of higher and lower, in the manner of organs, made a pleasing music by the dissonancy of sounds: treble, tenor and bass, exactly corresponding and answering each to other; with these pipes they often played in consort, and made tolerable music, though they wanted the quavers, semiquavers, airs, and many voices which perfect the harmony amongst us.[1]

These pipes are as popular with the modern Indians as they were with their ancestors in the days of the Inca. Indian couriers frequently use this instrument to announce their arrival and departure, as the post-horn was used by the driver or guard of a mail coach in England, and as it was by a New York coaching party.

E. G. Squier, who witnessed the *chuño* or potato festival of the Aymará Indians, says:—

Each group danced vigorously to its united music, which made up in volume what it lacked in melody—wild and piercing, yet lugubrious: the shrill pipe [panpipe] and the dull drum, with frequent blasts on cow's horns by amateurs among the spectators, filled the ear with discordant sounds. Every man seemed anxious to excel his neighbor in the energy of his movements, which were often extravagant; but the motions of the women were slow and stately. The music had its cadences, and its emphatic parts were marked by corresponding emphatic movements in the dance. The 'devilish music' that Cortez heard after his first repulse before Mexico, lasting the livelong night, and which curdled his blood with horror, while his captured companions were sacrificed to Huitzlipochtli, the Aztec wargod, could not be stranger or more fascinating, more weird or savage, than that which rung in our ears during the rest of our stay in Tiahuanaco.[2]

Lieut. Gibbon describes the "church performances" of the Aymará Indians thus:—

The wind-instruments are made of a succession of reeds of different sizes and lengths [panpipes], upon which they blow a noise, little resembling music to our ear, keeping time with the drummers, the slow-motioned dancers respecting them both. . . . The women again appeared, each bringing with her a jar of *chicha*, which they served out in cups, giving to each individual as much as he could drink, which was no small quantity, for the morning was cold. The music again struck up, and the women again joined in the dance. One of them came out with her sleeping 'wawa' slung to her back, which soon commenced a laughable discord; but not a smile could be discovered in any of their faces; neither did the woman stop till the dance was ended.[3]

Bearing this description in mind, it will be interesting to turn to Plate V, Fig. 2, which represents figures of men and women in relief, forming a band around a pottery water vessel. There is every reason to

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[1] *Royal Commentaries of Peru*, Ed. Rycaut, Part I, Book II, Chap. XIV.
[2] *Travel and Exploration in the Land of the Incas*, 306, 307.
[3] Gibbon, Lardner, and Herndon, W. L., *Exploration of the Valley of the Amazon* (Washington, 1854), 117, 118.

believe that the potter who moulded these figures was gathered to his fathers long before the coming of the Spaniards, yet he depicts the identical scene described by Lieut. Gibbon after so great a lapse of time, showing how such customs persist with these Indians. The musicians play upon panpipes and the drum. The woman with her "wawa" (baby) strapped to her back is here, nor are the jars of *chicha* wanting. *Chicha* is a fermented drink made of maize, and is still the national drink of the Indians. J. Skinner relates that,

> In alternation of dancing, singing, and drinking they remain for several days and nights without intermission, until all the jars are empty. Father Figueroa pleasantly observes that he is at a loss to conjecture how they have a head for so much noise, a throat for so much exclamation, and a tooth for so much liquor.[1]

Since the rustic god, Pan, played upon his pipe in Arcadia, his invention has been the most highly developed musical instrument among hundreds of barbarous and semi-civilized peoples. It was in use in South America before Columbus, where it was found from the Isthmus of Panama to central Chile. It is doubtful if the panpipe was used in North America in prehistoric times. The double whistle, blown in the same way, appears to have been the nearest approach to it. The very early use of the panpipe in South America precludes the idea that it was an importation from the Old World, and stamps it as an independent invention of the Indians of that continent.

The instrument is familiar to us under the names of panpipe, panflute, syrinx, and mouth organ. It is undoubtedly the precursor of our great modern organs; we find it mentioned in the Old Testament (Gen. IV, 26) where it is called organ. In its most common form it consists of a number of reeds of graduated lengths, fastened together either by cords or splints of cane, or by both splints and cords. The upper ends form a horizontal line and the lower a series of steps. Generally, the reeds are cut off below the nodes which make them closed or stopped pipes. The quality of a stopped pipe is reedy and veiled because of the absence of harmonics of even numbers. The wave must traverse the length of the tube twice as it is reflected by the closed end. The result is that another node is set up at one-third of the length from the upper end, the second harmonic at one-fifth of the length, thus dividing the lower four-fifths into two equal parts. In the open reed the first harmonic is the octave of the fundamental tone; in the closed reed it is the twelfth. Sometimes these instruments are made with two rows of reeds in which case the reeds

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[1]Skinner, Joseph (Ed.), *The Present State of Peru: comprising its Geography, Topography, Natural History, Mineralogy, Commerce, the Customs and Manners of its Inhabitants, etc.* London, 1805. (290).

in the second row are open throughout their length and are generally so arranged that each closed pipe has an open one opposite to it that gives the octave.

Two panpipes fastened together by a long cord and played by two performers are very common in Bolivia today. Each instrument has but half the notes of the scale, every other one being absent, and these must be given by the man playing the complementary pipe.

Panpipes are usually made of some kind of cane or reed, but occasionally of wood, metal, stone, and terra cotta.

Mr. Safford encountered at Puno, on Lake Titicaca, an orchestra composed entirely of panpipes. He says:—

> The performers, who were full-blooded Quichua Indians, sounded the pipes by blowing across the opening of the inner or closed reeds, the corresponding outer open reeds apparently serving the purpose only of giving volume or quality to the note sounded.[1]

These instruments heard by Mr. Safford were tuned to our scale and he states that this orchestra played the national air of Peru in a creditable manner.

Erland Nordenskiold says:—

> When studying Indian musical instruments we must bear in mind that, in post-Columbian times, they have learned a good deal from the Whites and negroes.
>
> At the mission stations the Indians are always instructed by the missionaries in music. At the Bolivian mission-stations it is not unusual to come across Indians who very well understand musical notation, though unable to read or write. At the Chiriguano mission stations there are full-blown musical bands.[2]

In the Montero collection from prehistoric graves at Ica, Peru, the American Museum has a panpipe which has some remarkable peculiarities in its construction (See Fig. 1). It has fourteen reeds in two rows; one row with reeds open throughout their length; the other, closed at the lower end. The closed reeds are not stopped by a node of the cane, but by a piece of gourd so nicely cut and fitted as to be airtight. This is the first time I have seen the reeds of a prehistoric panpipe so closed.

There is still a greater peculiarity at the upper ends of the open pipes. The reed was not cut off below the node, but through it, in such a way as to leave some of it partly closing the bore. A notch was then cut into the rim of the cane, and something in the nature of a punch used in this notch to force some of the substance of the cane through into the bore in the form of a small sharp point. Fig. 2a shows a section of the cane and Fig. 2b the upper end of one as it is in this instrument.

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[1]Safford W. E., Panpipes (*Journal, Washington Academy of Sciences*, vol. 4, no. 8, 1914).
[2]Nordenskiold, Erland, "The Changes in the Material Culture of Two Indian Tribes under the Influence of New Surroundings" (*Comparative Ethnographical Studies*, No. 2, Goteberg, 1920), 116.

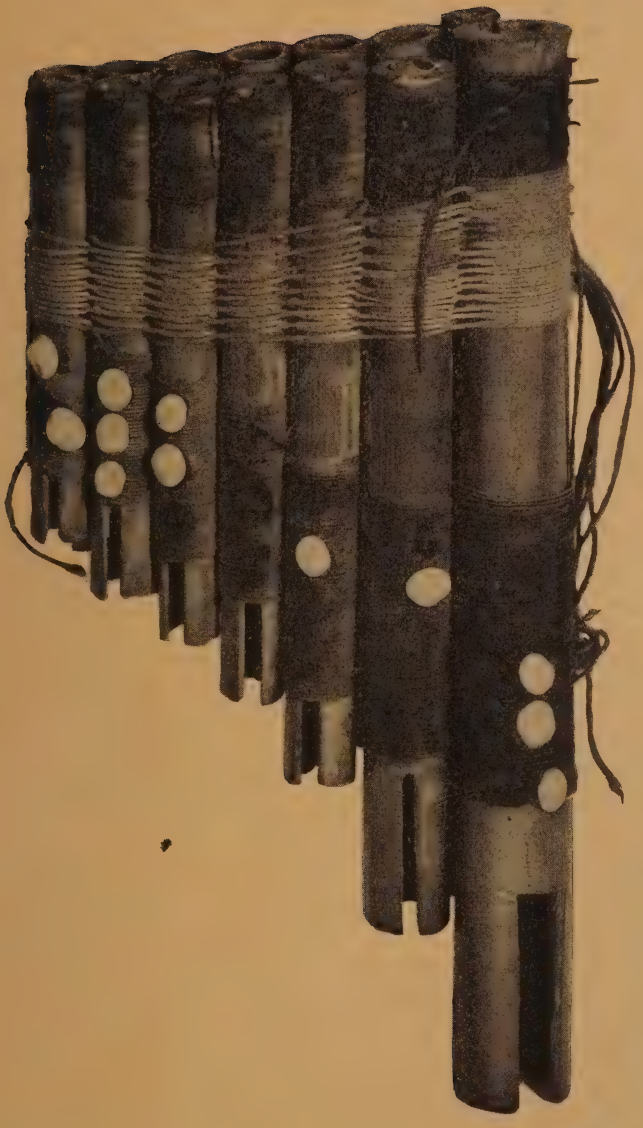
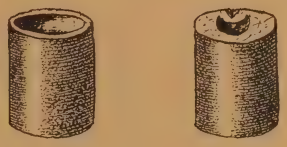


Fig. 1 (41.0-1626). Prehistoric Panpipe from Grave in Ica, Peru.

Such reeds do not give out a full volume of tone, but are shrill, like the sound produced by blowing across a small key. They could never have been used in conjunction with the closed reeds, as aside from the difference in volume and quality they do not give the octave of the shorter closed reed, with which they are paired.

Carl Ribbe describing some musical instruments of the Solomon Islanders says:—

> The best perfected instruments are the so-called Pan-pipes having two rows of reeds. These are not of the kind where the reeds are played upon that lay against the mouth, the breath being blown over them into the outer row.[1]



a *b*

Fig. 2. *a*, Section of the Cane of one Reed in the Panpipe shown in Fig. 1; *b*, Upper End of a Reed in the Panpipe in Fig. 1.

Considering what Safford and Ribbe have said, are we warranted in assuming that the set of open reeds in our Ica pipe was perfectly useless, for I cannot see how such reeds can act as resonators?

It does not seem probable that so much work and ingenuity would have been expended in fashioning pipes in so peculiar a manner if they were not expected to play some part in the music produced; but it is useless to try to fathom the workings of the primitive mind. Still another odd feature of this panpipe is that the longest open reed is three times the diameter of all the others.

It is not possible to give an absolutely correct scale for a set of reeds that has been buried in the ground for perhaps a thousand years, as the cylinders are no longer true; some are badly cracked, and all are more or less injured. When I say scale, in connection with prehistoric Peruvian musical instruments, I use the word with considerable mental protest. Scale implies a regular fixed succession of intervals. Of course, I do not expect a primitive man to make two flutes or two panpipes exactly alike; but I have never yet found two near enough alike to lead me to believe that this had been attempted.

Following are the theoretical vibration numbers of the seven closed reeds of this Ica panpipe, as determined by the length of the air columns, found by measuring the length of the reeds inside:—

1137.93	755.25
1080.30	651.57
958.92	566.73
872.80	

[1]Ribbe, Carl, *Zwei Jahre unter den Kannibalen der Salomo-Inseln* (Dresden, 1903), 135.

In sounding the different notes of such an instrument, we seldom find a single one that is exactly, in pitch, like any one in our diatonic scale. All that can be done in such a case is to give it the name of the note that it most nearly approximates. In this case they may be written: —D—B—B^b—G—F—E^b—D. This is in as close agreement with the theoretical vibration numbers as can be expected.

The Museum has a panpipe from a grave in Arica, Chile. The reeds were all formerly stopped by nodes which have been mostly broken out. Reckoning from the inside measurements of the canes the vibration numbers are:—

666.75	406.40
576.68	372.23
513.96	333.37
458.83	333.37

This pipe is peculiar in that the two longest reeds are of exactly the same length.

There are four panpipes from New Guinea in the Museum's collections. One has four canes, the others only three. The canes are held in place by cords near the top and bottom. In one case the cord is made of human hair; in the others, of some vegetable fiber. All are closed near the lower end by the node of the cane. Two of these pipes give the following vibration numbers:—

402.56	632.16
414.29	457.54
379.30	520.63
	592.66

The first pipe has its shortest reed in the center, while in the other we find the shortest on the left, followed by its longest. The vibration numbers seem to show that no attempt was made to tune these pipes to any scale. If any crude approach to an air was played on one of them, it could not be duplicated on the other.

Figs. 3 and 4 show two panpipes in terra cotta. They are part of the Eleodora Pachas collection from prehistoric graves in Nazca, Peru. This valuable collection which contains some four hundred pottery objects is now the property of the Museum of the American Indian, Heye Foundation, whose authorities have kindly loaned me these panpipes for study and publication.

The larger of the two measures 28.5 cm. on the side of its longest "reed", the smaller, 14.5 cm. Both instruments have ten tubes with

openings at the upper end in the form of an ellipse; but on looking into them they are seen to be otherwise perfectly cylindrical. They appear to have been made by introducing a cylindrical piece of wood or a section of cane while the clay was plastic, and pressing the material to this core. After this was withdrawn the opening was pressed out round.

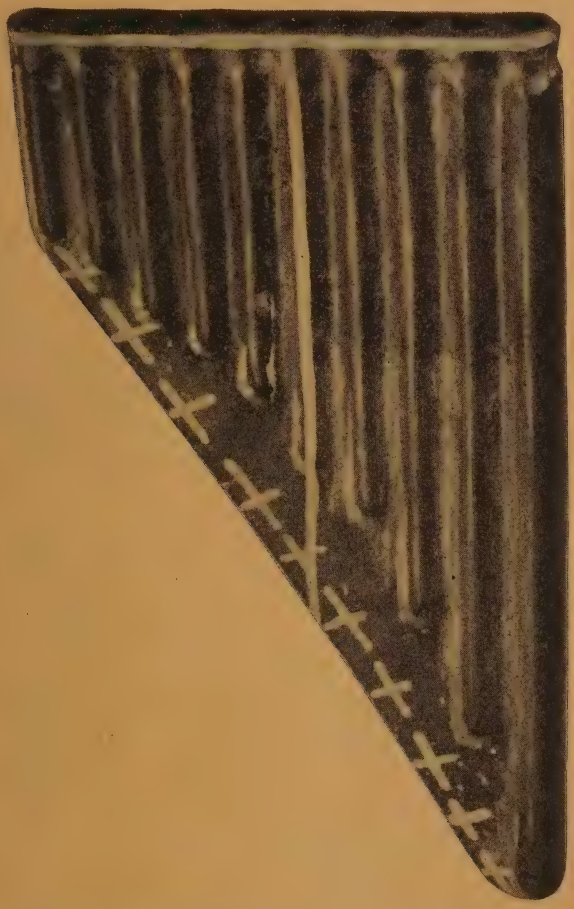


Fig. 3. Terra Cotta Panpipe from Grave in Nazca, Peru.
Courtesy of Museum of the American Indian, Heye Foundation.

These pipes sound very freely, giving forth a loud, penetrating tone, somewhat metallic in quality. Both are painted in two colors, dark gray or chocolate color and bright red. Each of these colors covers about half of their surface and is separated by a line of white. Chocolate color

and red are not differentiated in a photograph, but the white line running lengthwise, shows the division between the two colors. Both are decorated with white crosses. Below are the vibration numbers of the tubes

Fig. 4. Terra Cotta Panpipe from Grave in Nazca, Peru. Courtesy of Museum of the American Indian, Heye Foundation.

in these instruments. The column at the left is for the larger panpipe, the one at the right for the smaller panpipe.

310.59	613.39
372.71	779.32
476.25	592.50
585.01	1174.32
649.43	1318.84
793.75	1558.64
902.36	1824.46
1008.52	1993.60
1207.74	2449.28
1382.66	2857.50

Panpipes and Culture Connection. The highly advanced state reached in several of the arts in parts of America before the discovery by Columbus has naturally led many to the belief that at some remote time there had been communication between the peoples of the Old and the New World.

First and last almost every eastern country has for a time done duty as the source of this or that thing found in America. When any American form has been found to be similar to that in any distant land (for example, Dr. Graebner's claim in connection with crutch-paddles)[1] cultural connection has often been seen, little consideration being given to the possibility of independent invention.

Of late years several anthropologists have turned their attention to the South Sea Islands, believing that they have discovered convincing evidence of cultural connection between their peoples and those in parts of South America. As the most striking argument in support of this theory deals with the old Inca musical instrument, the panpipe, I shall give its claims with comments.

In his paper entitled: "Ueber ein akustisches Kriterium für Kulturzusammenhänge"[2] Dr. Erich von Hornbostel believes he has produced indisputable evidence of culture connection between the peoples of the South Sea and Northwest Brazil, by means of similarities in their panpipes.

Although Dr. von Hornbostel's claim has been endorsed by some ethnologists I have seen no reason to change the opinion I formed of it when the article appeared: that it was a remarkably good and painstaking piece of work, and convincing, if further tests gave the same results as he had undoubtedly obtained, which, however, seemed to me could not possibly be the case.

For a better understanding of what follows I give here his opening sentences:—

> If one surveys the manifold forms of the Panpipe and its distribution over the world one cannot overlook the fact that the type having double rows—that have opposite each closed pipe an open one (of about the same length) which gives the octave—is only found in two limited territories widely separated: in the Solomon Islands, and in western Polynesia (Fiji, Samoa) on one side, and Peru and Bolivia on the other. Even the characteristic ligature of the Solomon Islands—flat sticks with threads strung crosswise—is found in Peru and Brazil.

Here we are referred to this somewhat contradictory footnote:—

> It is true that similar ones are found elsewhere, for instance in upper Egypt.

Dr. von Hornbostel's principal claim to a discovery of cultural connection between the peoples of Polynesia and of northwestern Brazil rests on a most peculiar musical scale which he believes common to the two localities. In a technical paper "Ueber einige Panpfeifen aus Nordwestbrasilien"[1] he describes this scale at length, calling the intervals a

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[1] Graebner, F, "Krückenruder" (*Baessler-Archiv*, III, 1913), 191–204.
[2] *Zeitschrift für Ethnologie*, XLIII, 1911, 601–615.

circle of fourths (eine art Quatenzirkel). He says it is formed by the help of partial tones caused by over-blowing. His description of how an Indian may duplicate a panpipe will fully explain the nature of his scale.

The Indian may take the longest reed for measure and pitch. For the third reed he must cut one of a length that when overblown its first partial tone (a twelfth above the fundamental) will be identical with the double octave of the first reed. He is to proceed in the same way to cut his fifth reed by the third and so on with the odd numbered reeds. For the even numbers he begins by halving the interval between the first and third for the second reed, after which the other even numbers are made in the same way as the odd numbers.

Dr. von Hornbostel gives the following table of vibration numbers which he obtained from two panpipes, one from northwest Brazil, the other from the Solomon Islands; also the theoretical vibration numbers.

	1	2	3	4	5	6
Brazil	415.5	481.5	560.5	651	374.5	439.5
Theoretical	415.5	481.6	559.6	650.4	378	439.2
Solomon Islands	415	473	557	651	379.3	440

Only the results he obtained from the first six reeds are given. Dr. von Hornbostel is a scientific, careful workman and I have not the least doubt as to the correctness of his vibration numbers although they are practically alike, wonderfully near when we consider that the reeds were cut by two primitive peoples so far separated, and that these panpipes were copies of others that had been made through the centuries. I can only see in these figures a very remarkable coincidence; otherwise, I must believe that two primitive peoples with no delicate standard instrument have retained, for many generations, an absolute pitch, a tone with just so many vibrations to the second, and have done this by some cutting instrument, wild reeds, and the human ear. I feel sure any manufacturer of wind instruments would declare this an impossibility.

Dr. von Hornbostel tells us that to prove cultural connection the panpipes must be similar in construction, have the same scale, and be practically alike in absolute pitch. Now the Solomon Islands pipes are made of two rows of reeds; one row with the lower ends closed, the other row open to give the octave. The Brazilian pipes have the reeds all in one row with the lower ends all closed. The manner of fastening the reeds together varies, but is often the same as in the Solomon Islands, which, however, is not peculiar to these two regions. Except for the liga-

[1]See Koch-Grünberg, Theodor, *Zwei Jahre unter den Indianern* (Berlin, 1909–10), Vol. 2, 378–391.

tures which keep the reeds in place it will be seen that they differ radically in construction.

I have lately examined fourteen panpipes from the Rio Caiary-Uaupés. It was on this river that Dr. Koch-Grünberg collected the Brazilian pipes studied by Dr. von Hornbostel. It was my intention in the beginning of this investigation to have determined the vibration numbers of these fourteen panpipes; but after working out two of them with the following results, and sounding the notes of the other twelve I found them to vary so greatly (no two very near together) that it seemed a waste of time and labor to continue. I met with no success in trying to find a uniformity in the pitch relationship of the reeds of the different instruments. In fact, the same scale (?) cannot be played on any two of them.

1122.94 870.80 661.05 508.00 396.94 306.90 249.55 193.09 141.00
1040.78 870.85 735.72 584.55 488.02 367.64 296.45 245.37

Flute. On Plate IX, twenty-six flutes are represented. Nos. 1, 2 and 3 are of cane; Nos. 7, 8 and 9 are made from the wing bone (ulna) of the pelican; Nos. 11, 12, 14, 15 and 16 from combined ulna and radius of the llama; No. 13 is a small gourd. All the others are made from the ulnæ of deer. They are simply tubes, open throughout their length, and all belong to the class known as "end-blown."

In playing, the breath, crossing the opening at the upper end, impinges on the sharp edge, which is often notched, setting up vibration in the column of air within the instrument, thus producing the sound. It is a well-known law that the frequency of vibration, or, in other words, the pitch of a note produced, depends chiefly on the length of the column of air within the flute.

In the flutes represented the vents or holes for changing the length of the vibrating column of air vary in number from three to seven. In those made of cane they are all on the upper side, while the bone flutes often have one of the holes on the under side, which was closed by the thumb. Nos. 4, 5, 6, 10, 11, 14 and 17 to 26 are of the latter kind.

Many of the scales on pp. 338–339 are written an octave lower than those produced from the instruments. This brings them all within a reasonable compass and makes it much easier to compare their intervals. It must always be kept in mind that the written note is in many cases not the one given out by the instrument, but the one nearest to it in our diatonic scale.

All attempts to discover any rule or law governing the positions of the openings or vents have been unsuccessful. A first glance at several

of these flutes, particularly those made of cane, gives the impression that an attempt at equal spacing had been made; but a second shows such a variation in distances that this seems doubtful. The bone flutes (Plate IX, Figs. 25 and 26), are of the same length, yet a great difference in the position of the holes is apparent at a glance. We are led to the conclusion that these ancient flute-makers were not governed by set laws, but that each made his instrument according to his own idea. That the tones produced are in false key-relationship is not to be wondered at when we consider the imperfections in their construction; in fact, the flutes are sadly out of tune. What the late John Comfort Fillmore wrote of the Omaha flageolet Indian may apply equally to these flutes:—

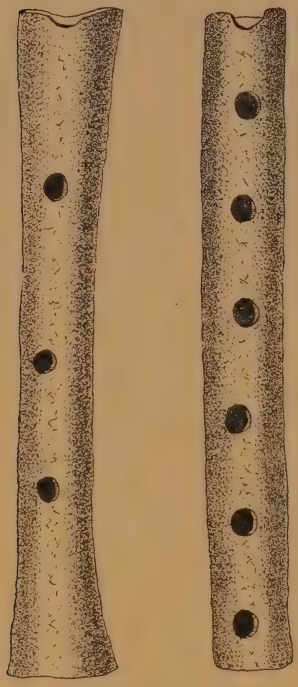

Fig. 5 (B-7946, 3846). Bone Flutes.

> The imperfections are plainly due to the limitations, not of the Indian's perception, so much as of his scientific knowledge. The flageolet is evidently built "by guess," and only remotely approximates to the Indian voice in accuracy of intonation.[1]

Those acquainted with the difficulties that beset the maker of a flute at the present day will see nothing strange in the lack of method in the location of the vents in the flutes of these ancient Peruvians. Mr. Wead remarks:—

> In practice these holes never can open so freely to the outside air that the portion of the tube beyond them may be considered as removed (the possibility or necessity of cross-fingering proves this to the player), so that the proper location and diameter of the holes to produce the notes of our scale of even quality are fixed, not by a simple law, as the frets on the guitar are located, but by laborious experimenting to get a standard instrument which is then reproduced with Chinese fidelity.[2]

The question arises, were the intervals produced on these flutes satisfactory to the Indian? That the first attempt was not so in very many cases, we know from the indisputable evidence of his work. Fig. 4 of Plate IX, shows the under side of a flute. It will be seen that the original

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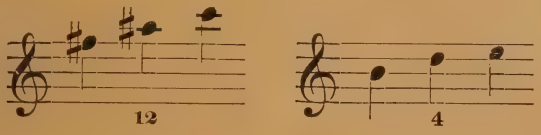
[1] *Omaha Indian Music*, Alice C. Fletcher, Appendix, 73.
[2] Wead, *ibid.*, 426.

thumb hole has been closed (by a stopper made of gourd) and another perforated above it. No. 7 has had four of the six original holes plugged and others bored near them,—only traces of the gourd plugs remaining. No. 17 shows plainly the plug in the original hole, and the vent which was afterward made above it. No. 19 shows two sets of holes. Of the plugs, only traces remain; but the one in the under side (thumb hole) is still in as perfect condition as those to be seen in Figs. 17 and 21. In No. 20 they have entirely disappeared. The scales of the twenty-six flutes shown on Plate IX are given on pages 338 and 339. They have been carefully determined in conformity with the international pitch: vibration number $a^1 = 435$.

Many of the tones produced from these instruments only approximate, in pitch, to some one of the notes of our familiar twelve tone piano scale. In many instances the variation amounts to nearly a quarter of a tone. Considering the age and condition of these flutes, it is safe to say that in some cases the scales given here are incomplete, and this applies particularly to those made of cane.

No. 14 of this set appears much longer than it really is,—the bird figures being carved on a prolongation of one side of the bone, below the tube.

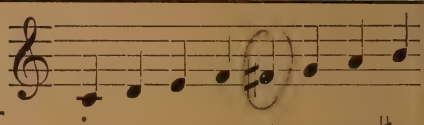
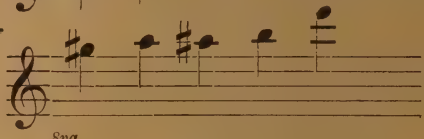
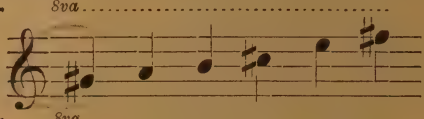
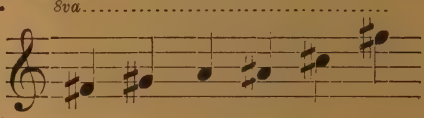
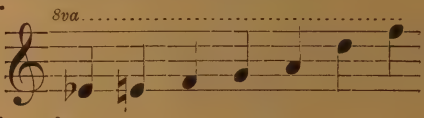
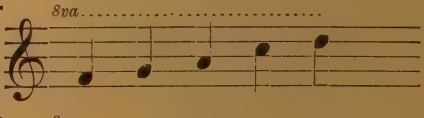
Nos. 4, 11 and 12, represented on Plate VIII, may be classed with the flutes. No. 12 is made from a shell (*Fasciolaria princeps*, Sowb.). It has two vents: one perforated through the top of the spire, the other in its side. No. 4 is an imitation of a shell in terra cotta. It is decorated with a human face and geometrical designs, which are not shown in the illustration. The scales of these flutes are given below:—



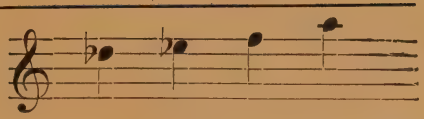
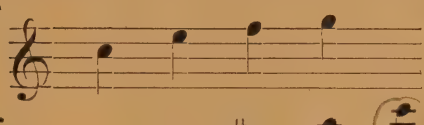
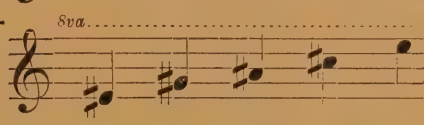
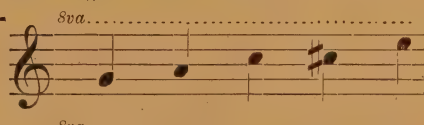
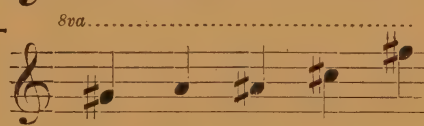
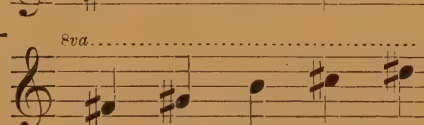
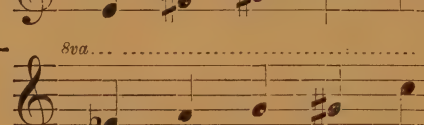
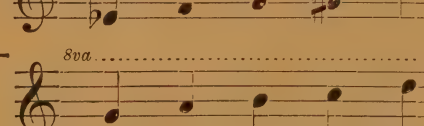
No. 11, also of terra cotta, is broken and the scale cannot be ascertained. These instruments are sounded by the breath impinging on the sharp edge of the outer lip of the shell.

Fig. 6 shows a terra cotta flute from a prehistoric grave at Ica, Peru. It is a new style of flute to me, inasmuch as the lower end is turned up at a right angle to the body of the instrument. It is of the end blown type, $8\frac{3}{4}$ inches long, and has five vents on the upper side, also one for the thumb on the under side, between the fourth and fifth vents above. Whether the opening in the turned up end, which looks

DESCRIPTIONS OF FLUTES REPRESENTED ON PLATE IX.

Figure.	Museum No.	Length in inches.	Scale.
1	B 3852	$15^{13}/_{16}$	
2	B 8139	$10^{1}/_{8}$	
3	B 8138	$9^{7}/_{8}$	
4	B 3509	$3^{7}/_{16}$	
5	B 382	4	
6	B 505^{B}	$4^{3}/_{8}$	
7	B 3848	5	
8	B 3846	$4^{9}/_{16}$	
9	B 3847	$4^{9}/_{16}$	
10	B 618	$6^{1}/_{4}$	
11	B 7945	$5^{1}/_{4}$	
12	B 7951	$7^{1}/_{8}$	

NOTE: The flute materials are: 1 to 3, cane; 13, gourd; the remainder, bone.

Figure	Museum No.	Length in inches.	Scale.
13	B 8013	3	
14	B 4929	$6\frac{1}{8}$	
15	B 2648^{A}	$6\frac{7}{8}$	
16	B 2648^{B}	8	
17	B 7944	$6\frac{3}{4}$	
18	B 7954	5	
19	B 7955	$4\frac{1}{2}$	
20	B 7948	$4\frac{1}{4}$	
21	B 619	4	
22	B 7949	$5\frac{3}{8}$	
23	B 505^{A}	$4\frac{5}{8}$	
24	B 7946	6	
25	B 505^{C}	$5\frac{1}{4}$	
26	B 750	$5\frac{1}{4}$	

like a vent, was stopped or not, there is no means of knowing. This makes it useless to attempt to determine its scale. The flute is of black ware and, as the photograph shows, is decorated with incised designs on the upper side, and has a puma figure near the upper end. This puma was moulded and attached to the instrument before firing. It is a powerful instrument and the tones, although so loud, are not disagreeable in quality.

Fig. 6 (41.0-1625). Terra Cotta Flute from a Prehistoric Grave at Ica, Peru.

Resonator Whistle. Whistles of the resonator class have a wide distribution and have been found in different sections of Peru. They are usually made of terra cotta, but sometimes of other materials. The kind most commonly met with emit but one or two tones and generally go by the name of signal whistles or bird-calls. The resonator type reached its highest form of development in Chiriqui and parts of Central America, where they commonly took the human form or that of some well-known animal or bird, and in most cases the grotesque element predominated in the representation. The openings (vents) to the air chamber in the body of these instruments vary in number, but seldom exceed four. Plate VIII, Fig. 13 shows an instrument of this class. This specimen is one and three-eighths inches high, and measures two and three-quarters inches from the nose to the tip of the tail. Its two vents are on the same side, yielding the following scale:—

No. 15, on the same plate, is of wood and has one vent. Its tones are:—

No. 6, on Plate VII, and Nos. 8, 10, and 14 on Plate VIII, are without vents and have but one note each.

Whymper, who gives an excellent account of the Incan remains in Ecuador, figures three of these whistles grotesquely resembling the human form. He has this to say of them:—

> Then there are the musical pottery whistles, delightfully ugly things, which are sometimes more useful to carry than letters of introduction. Simple airs can be got out of them, and on the homeward journey my people lightened the way by playing on these primitive instruments.[1]

Fig. 7 (B-9585). Gold Ornament from Trujillo, Peru, showing Trumpets in Use.

Trumpet. The trumpet in its various forms is undoubtedly one of the most ancient of wind instruments and its distribution in prehistoric times was all but universal. Two forms of this instrument were common in Peru: the conch and a trumpet of terra cotta. Both of these forms are shown in Fig. 7.

This illustration shows the ornamentation on one side of a gold ornament found in a prehistoric grave at Trujillo, Peru. It is double-convex in form, consisting of two thin, concavo-convex pieces which are not joined by solder, as is sometimes the case in ornaments of this kind, but are held together by the edges of one of the pieces being turned tightly over the other. The figures are in *repoussé* work.

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[1]Whymper, Edward, *Travels amongst the Great Andes of the Equator* (New York, 1892), 281.

Plate VII, Fig. 1 represents a remarkably fine specimen of the shell trumpet. It has a copper mouthpiece, and is ornamented with an engraved figure of a warrior. The shell is a *Strombus galeatus*, Swains. Unfortunately the mouthpiece is so badly corroded that the scale of the instrument cannot be ascertained. Fig. 2, on the same plate, is of a terra cotta trumpet and is one of several in the collection in which the shell form has been reproduced in clay. It would seem that this was frequently done when shells could not be obtained. This specimen is in perfect condition. Its scale is as follows:—

Fig. 8. Blowing a Shell Trumpet in Prehistoric Mexico. From a pictorial manuscript in the Florentine Biblioteca Nazionale, Folio 23.

The lowest or fundamental tone is produced on the open instrument; the next step above in the scale, by introducing the hand a short distance into the opening of the "shell." For the next higher note the hand is pushed still farther into the cavity, and so on until the highest tone of the instrument is reached. In the older natural or French horn, the so-called stopped tones are obtained in much the same way.

Fig. 8 shows that the shell trumpet was played in exactly this way in Mexico in prehistoric times. This illustration is from a Pictorial Manuscript in the Florentine Biblioteca Nazionale, Fol. 23. See Codex Vaticanus B, Seler, p. 162.

Plate VIII, Fig. 9 represents a clay trumpet similar to that represented on the gold ornament from Trujillo figured on page 341; the only difference is the shape of the "bell" which in the latter takes the form of an animal head. Besides its fundamental tone (B), only its octave can be produced. The other harmonics or overtones, on account of the material and its faulty construction, are absent. Nos. 5 and 6, on the same plate, are trumpets of wood. The mouthpieces are shallow and cup-shaped, as in No. 9, just described. No. 6 is badly cracked; but No. 5 is entire, and the following tones can be produced from it:—

The trumpet is frequently mentioned in the early accounts of Peru. Garcilasso, giving an account of the battle between the army of the Inca Viracocha and the Chanchas, says:—

> Both armies remained the whole night upon their guard with sentinels set on each side; and in the morning, by break of day the squadrons arming themselves, with great noise and shouts, with sounds of trumpets, and timbrels, and cornets, they began the onset.[1]

Alonso de Ovalle remarks:—

> The sound of the drum and trumpet is only to show them the necessity of their meeting in arms.[2]

Prescott tells us that at the siege of Cuzco (1536):—

> The Spaniards were roused by the hideous clamor of conch, trumpet and atabal, mingled with fierce war-cries of the barbarians.[3]

Quite a number of instruments that have been described as trumpets are found in South America. Some of these are eight feet or more long. They are variously made of cane, bamboo, wood, and bark wound spirally. Many are true trumpets, either end or side blown, while others belong to the flute or flageolet class. A trumpet called *Juruparis* is found on the Uaupés River. It is always kept in a secret place and at the time of the celebration of a certain ceremony is brought out at night and sounded outside the *molocca*. Women may not look upon this trumpet on pain of death. A similar instrument is also found on the Orinoco. It does not appear that the Inca had any of these trumpets as none of them have been found in their graves, nor are they represented on their pottery vessels.

Double Whistling Jar. Plate VIII, Fig. 3 shows a double musical water bottle. It consists of two pottery vessels connected near the bottom in such a way that water passes freely from one to the other. Near the top of the first or front jar (usually surmounted by a human or some animal figure) is the opening of the whistle. When the jars have been partly filled and are swung backward and forward, a series of whistling sounds is produced. As the vessel swings forward and upward, the water is lowered in the first jar and raised in the other; in the backward motion it rushes back into the first, forcing the air out through the

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[1] *Royal Commentaries of Peru*, Part I, Book V, Chap. XVIII.
[2] *An Historical Relation of Chile*, (John Pinkerton, *ed.*, London, 1813), 122.
[3] *Conquest of Peru*, Vol. 2, 47.

whistle. It has often been said that the sound emitted by these jars resembles the cry of the animal represented on the vessel. A careful examination of eighty-five of these whistling jars leads to the conclusion that this is the result of a lively imagination—that they are whistles pure and simple.

Plate VII, Fig. 4 shows a nondescript instrument made of terra cotta. The tone is produced by blowing into either of the two holes in exactly the same manner that the trumpet is sounded. The lips, in both cases, act as reeds, causing the vibration of the air within the instrument.

Stringed Instruments

A number of modern writers have stated that the *tinya*, a kind of guitar with five strings, was known to the Peruvians in pre-Spanish times. This seems as improbable as Ranking's story of fiddlers being attached to the court of Montezuma.[1] Garcilasso de la Vega, in his chapter entitled "Of the Geometry, Geography, Arithmetick and Musick known to the Indians," gives no account of any stringed instrument.[2] There is scarcely a chapter in the "Cronica del Peru" of Cieza de Leon that does not contain mention of some musical instrument, but we find no hint of instruments of this class. The Peruvians themselves, as we have seen, left behind them many of their instruments and numerous representations of them on their pottery vessels and metal ornaments; but among them all, not one belonging to the lyre type can be found. Professor O. T. Mason says:—

> After looking over the musical collection of the United States National Museum and such literature as has been collected by the Bureau of American Ethnology, I have come to the conclusion that stringed musical instruments were not known to any of the aborigines of the Western Hemisphere before Columbus.[3]

Professor E. S. Morse agrees with Dr. Mason that there is no evidence of a pre-Columbian stringed device.[4]

I believe that no claim has as yet been made for the existence of the musical bow in Peru; and what Dr. Henry Balfour says of this most primitive of stringed instruments is very important, as showing with what caution the evidence should be considered before pronouncing any instrument to be of pre-Spanish origin:—

> In viewing the various types of musical bow to be found in the New World, I must say that I feel that the case of the claims of this instrument to be regarded as indigenous (pre-Columbian) in the Americas can only as yet be dismissed with the verdict of *not proven*. I can find no absolutely convincing evidence to prove the case, and in view of the certainty of many varieties having been introduced by the immigrants from Africa, it will require very strong evidence to establish the claim.[5]

Although not conclusive, such evidence as we have at the present time is against the existence of any form of stringed instrument in Peru before the coming of the Spaniards.

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[1] Ranking, John, *Historical Researches on the Conquest of Peru, Mexico, Bogota, Natchez, and Talomeco in the Thirteenth Century, by the Mongols*, etc. (London, 1827), 344.
[2] *Royal Commentaries of Peru*, Part I, Book 2, Chap. 14.
[3] Mason, *ibid.*
[4] Appleton's *Popular Science Monthly*, March, 1899.
[5] *The Natural History of the Musical Bow* (Oxford, 1899), 50–51.

Conclusion

Undoubtedly the most important instruments were the drum, the various kinds of flutes and the panpipe. Early writers frequently speak of the Indians dancing to the music of the pipe and tabor. The ancient potters have left us representations of these scenes on their water vessels (Plate V, Figs. 1 and 2). These dances appear to have remained unchanged in 1649 when Alonso de Ovalle wrote this quaint account:—

> Their way of dancing is with little jumps, and a step or two, not rising much from the ground, and without any capers such as the Spanish use; they dance all together in a ring.[1]

A number of songs have been recorded which have been known to the Indians for generations, and believed by them to have been handed down unchanged, but their authenticity is, of course, doubtful—even the source from which they came being uncertain. Negroes were introduced early into all the Spanish colonies, and doubtless many of their tunes were adopted by the Indians. Garcilasso tells us that when he left Peru in 1560 there were then five Indians residing in Cuzco who were great masters on the flute, and could play readily, by book, any tune that was laid before them.[2] In view of these conditions, we may well be sceptical concerning the claims of any music said to be pre-Spanish.

We now come to that much vexed question, What musical scale was known to the ancient Peruvians? In the absence of any authentic music we must look to their instruments as the only source of information. It has been believed commonly that they employed the five-toned or pentatonic scale, so widely used in the primitive music of various peoples, which one of our most eminent musical scholars and critics insisted "represents a stage in musical development and is neither a racial nor geographical indication."[3] In this scale the step of a semitone is avoided by omitting the fourth and seventh degrees in major and the second and sixth in minor.

Some of the scales given in this paper seem to indicate the use of this five-toned scale, but there are puzzling exceptions. If there were five Indians at Cuzco alone, in 1560, who could play anything by note, there must have been many more in other parts of the empire. These Indians played from European music, and of course, were familiar with our diatonic scale. The number who are familiar with our diatonic scale has been constantly increasing for more than three hundred years, especially in the neighborhood of the larger towns where it is not uncommon to find

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[1] *Historical Relation of Chile*, 117.
[2] *Royal Commentaries of Peru*, Part 1, Book 2, Chap. 14.
[3] H. E. Krehbiel in *New York Tribune*, September 8, 1901

panpipes tuned to our intervals, or at least as near as the Indians could make them.

Some recent studies seem to prove that some of the old Inca music is still to be heard in the Peruvian sierras, and as songs are likely to be retained longer than almost any other feature of Indian life, this is possible. An article by Sr. Alberto Villalba Muñoz, in "Inter-America" for April, 1922, first called my attention to the work of Daniel A. Robles in recording Indian music. Muñoz says:—

> To Señor Daniel A. Robles, Peru today owes the key and point of departure that make it possible to recognize the true Incan music, and to distinguish it with absolute certainty from the colonial music.

This means that one is in the five tone and the other in our twelve tone scale. The Incan scale is given as follows:—Re, Fa, Sol, La, Do. This is the minor form of the pentatonic scale, using Re as the fundamental tone. In this scale there are no semitones. By substituting others of the above notes for Re as the fundamental we shall get major as well as minor keys.

Sr. Robles' claim that he has recorded the old Incan music is endorsed by Raoul and Marguerite d'Harcourt in "La Music dans la Sierra Andine de la Paz a Quito."[1] They state that they found Robles in Lima but were not fortunate enough to hear him render these airs upon the piano.

Later Madame d'Harcourt wrote down some two hundred Indian songs which they say gave them "A complete view of folk-music of the Andean region." Some of the recorded songs were pure Inca pieces in the five-tone scale, others they style mixed-breed. These last they consider to have been originally Incan songs that have been much changed since the Indians came in contact with the Spaniards.

Since writing the above I have met Señor Robles and by invitation passed a most enjoyable hour with him at his temporary New York home. I found him a very agreeable, intelligent gentleman, and an enthusiast in his work. He played to me quite a number of songs that he has recorded. They certainly are primitive; in the five-tone scale, and differ greatly from the modern Indian music.

After studying the work done by Señor Daniel A. Robles which has been confirmed by José Castro, Leandro Albiña, Monsieur and Madame d'Harcourt, and others, I think we may consider the scale problem solved. The Inca used the pentatonic scale.

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[1] *Journal de la Société des Americanistes de Paris*, N. S. Tome XII, pp. 21–54, 1920.

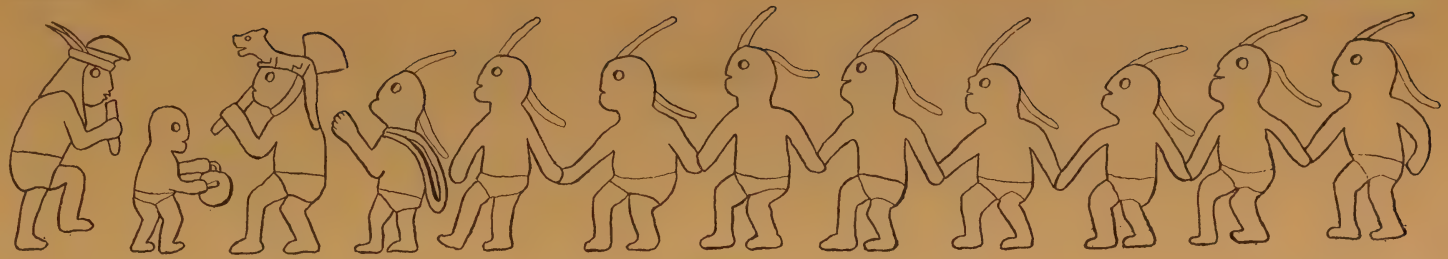

Figure 1.

Figure 2.

Decorations from Ancient Peruvian Terra Cotta Vessels showing Musical Instruments in Use.

Musical Instruments: Drums, Rattles, Bells and Cymbals.

Musical Instruments: Trumpets and Rattles of Shell and a Syrinx.

Musical Instruments: Whistles, Panpipes, Syrinx, and Trumpet.

Types of Peruvian Flutes.